i3 Micro Module

Edge-AI enabled Wireless Sensor Module
for Condition based Monitoring

Oct. 2023

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1. Overview

In many industrial applications, there is a need to prevent anomalies in machinery and equipment to minimize downtime. Productivity and efficiency can be improved by predicting problems, rather than reacting only after breakdowns have occurred.

TDK i3 Micro Module - Ultracompact, battery-powered wireless multi-sensor module - was designed to facilitate this type of predictive maintenance in any kind of industrial applications.

It achieves vibration sensing at almost any desired location without physical constraints such as wiring. This accelerates the prediction of anomalies in machinery and equipment, enabling an ideal implementation of Condition based Monitoring (CbM).

Monitoring through real-time visualized empirical equipment data instead of relying on manpower and scheduled maintenance, understanding the health of machinery and equipment to help extend uptime, and minimizing downtime by preventing unexpected failures - all contribute to establishing an ideal predictive maintenance system.

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2. Key features

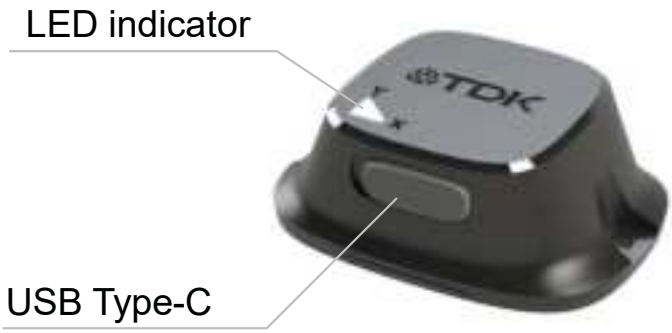
- Edge AI enabled anomaly detection
- Embedded algorithm for vibration monitoring
- Sensors: accelerometer, temperature
- Wireless connectivity: BLE and mesh network
- USB interface
- Replaceable battery
- PC software for data collection, AI training, and visualization

3. Main applications

- Factory automation
- Robotics
- HVAC equipment and filter monitoring

4. Target specifications

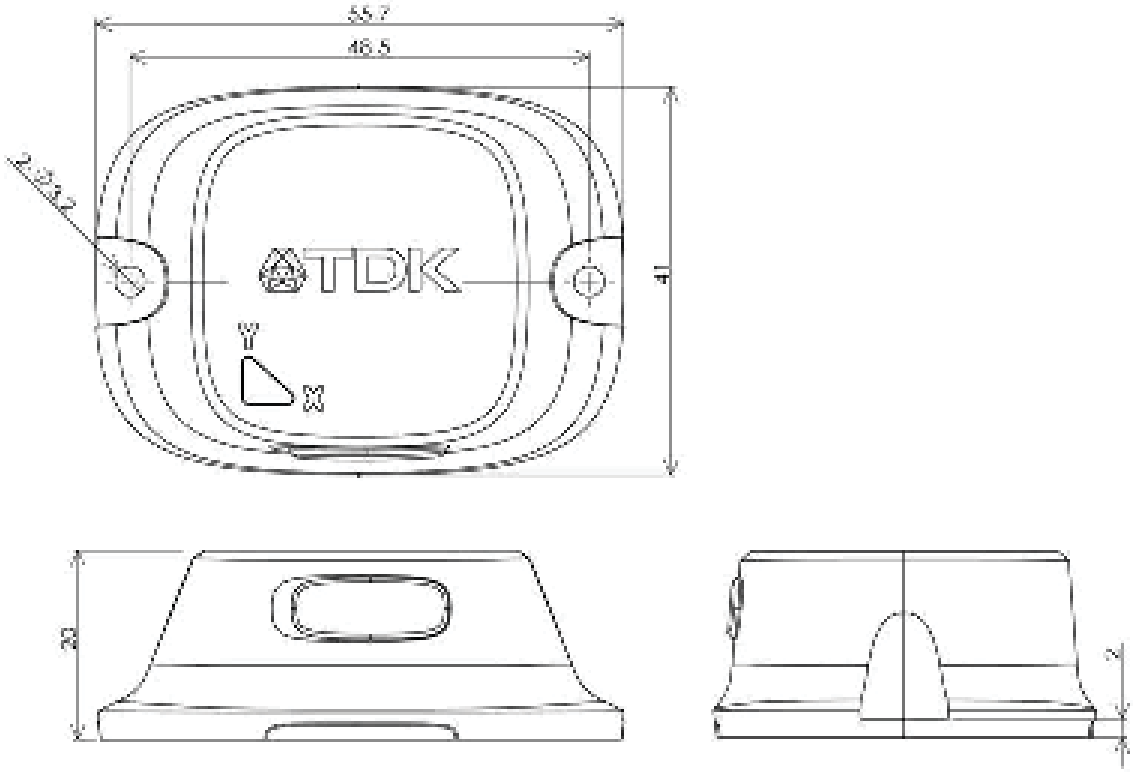
• i3 Micro Module



Item	Specification
Communication interface	
Wireless	Mesh / Bluetooth low energy
Wired	USB
Communication range (Line of sight)	
Mesh	< 40m (Sensor <-> Sensor, Network Controller)
Bluetooth low energy	< 10m (Sensor <-> Network Controller)
Operating condition	
Power Supply	Replaceable battery (CR2477) / USB
Battery life	2 years (1 hour of report interval)
Operating Temperature	-10 to 60degC
Mechanical specifications	
Dimension	55.7 x 41.0 x 20.0
Ingress protection	IP54
Mounting Type	Screw M3 x 2
Sensor – Vibration	
3-Axis Accelerometer	±2g, ±4g, ±8g, ±16g
Frequency Range	DC to 2kHz
Sampling rate	Up to 8kHz
Output KPIs	Min, Max, Peak-to-Peak, Standard deviation, RMS
Data streaming	Only supported in USB and Bluetooth low energy
Sensor – Temperature	
Measuring Range	-10 to 60degC
Accuracy	± 1degC (10 to 30degC) ± 2degC (<10degC, >30degC)

5. Outline dimension

- **i3 Micro Module**



6. Software

CbM Studio

CbM Studio is a PC software that can be used with the i3 Micro Module and provides the following features to make it easy to start implementing Condition based Monitoring.

- Sensor configuration
- Recording streaming data for AI training
- Feature analysis of streaming data
- Training of AI model
- Deployment of trained AI model
- Collecting & exporting sensor data
- Visualizing received sensor data
- Visualizing mesh network status

• System requirements

Item	Requirement
OS	Windows 10, 64bit
RAM	16GB
Hardware	USB 2.0 port

• Supported function

Sensor interface	Recording raw data	Deployment of trained AI model	AI inference operation
USB	✓	✓	✓
Mesh			✓
Bluetooth low energy	✓	✓	✓

7. Battery replacement

■How to install the battery

1. Insert the battery (CR2477) with the positive side (+) face up.
   Caution: Do not insert the battery with the polarities in the wrong direction.
   Hold the battery with claws.
2. Close the back cover by pressing down.
3. LED Indicator (Red/Green) lights up for a couple of seconds after turning on the power switch inside. If not, please make sure the polarity of the battery.

■How to remove the battery

1. Remove the back cover by using this concave.
2. Remove the old battery by using this concave.
3. LED Indicator (Red/Green) lights up for a couple of seconds after turning on the power switch inside. If not, please make sure the polarity of the battery.

■Important

- Do not use such a metal tweezer or a screwdriver when removing the battery.
- The supplied battery is for trial use. This battery can run out faster.

8. Safety precautions

IMPORTANT SAFETY INFORMATION

To assure the correct use of the product basic safety measures should always be followed including the warnings and cautions listed in this instruction manual.

■Warning

*Warning: Improper use may result in death or serious injury.

- Do not throw the battery into fire. The battery may explode.
- Please stop using this product immediately, if there is strange smell or smoke from the unit.
- Keep the unit out of the reach of young children.
- Do not subject the unit to extreme temperatures, humidity, moisture, or direct sunlight. Internal condensation due to severe change in temperature may cause malfunction.
- In high temperature or low temperature environment, battery life may be extremely short due to the characteristics of the battery used.

■Caution

*Caution: Improper use may result in minor or moderate injury to the user or damage to the equipment.

- Do not use the unit in the field of strong electromagnetic waves and static electricity.
- Do not insert the battery with the polarities in the wrong direction.
- Always use the type of battery indicated.
- Remove the battery from this unit when you are not going to use it for a long period of time (approximately 3 months or more)
- Do not replace the battery during the wireless communication.

■Precautions for Correct Use

- Do not disassemble or modify the unit.
- Do not subject the unit to strong shocks, drop it, step on it.
- Do not immerse the USB connector section in water. The external connector opening is not waterproof. Do not wash it or touch it with wet hands. Be careful that water does not get into the unit.
- Depending on the surrounding environment and the mounting position, the measured characteristic may vary. The measured values must be treated as a reference.
  (1) Do not subject the unit to extreme temperatures, humidity, moisture, or direct sunlight.
  (2) Do not use the unit where it will be exposed to dew condensation.
  (3) Do not subject the unit to extreme water droplets, oil or chemical materials.
  (4) Do not use the unit where it will be exposed to flammable gas or corrosive vapors.
  (5) Do not use the unit where it will be exposed to extreme dust, saline matter or iron powder.

- Batteries are not a part of your regular household waste. You must return batteries to your municipality's public collection or wherever batteries of the respective type are being sold.
- Dispose of the unit, battery, and components according to applicable local regulations. Unlawful disposal may cause environmental pollution.
- This Product operates in the unlicensed ISM band at 2.4 GHz. In case this Product is used around the other wireless devices including microwave and wireless LAN, which operate same frequency band of this Product, there is a possibility that interference occurs between this Product and such other devices.
- If such interference occurs, please stop the operation of other devices or relocate this Product before using this Product or do not use this Product around the other wireless devices.
- Application examples provided in this document are just for reference. In actual applications, confirm its functions, limitations and safety before using this Product.

9. FCC Notes and Cautions

■Product Name : Sensor Module

■Model Name : i3 Micro Module

■FCC ID : 2ADLX-MM0110113M

■FCC Note

- This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
- Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radiofrequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
- This transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

■FCC Caution

- Changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.

■RF Exposure Compliance

- This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines. This equipment should be installed and operated keeping the radiator at least 20cm or more away from person’s body.

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